FIG. 1

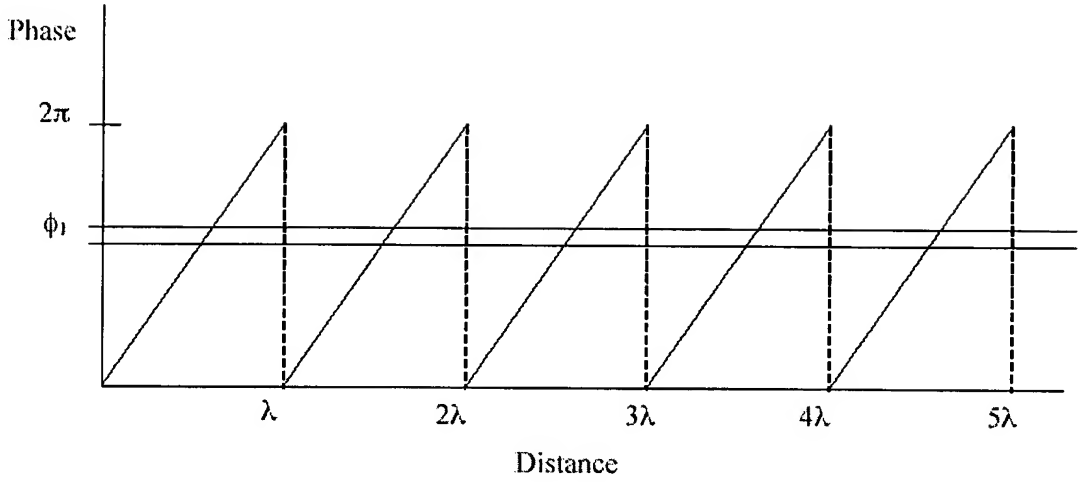


FIG. 2

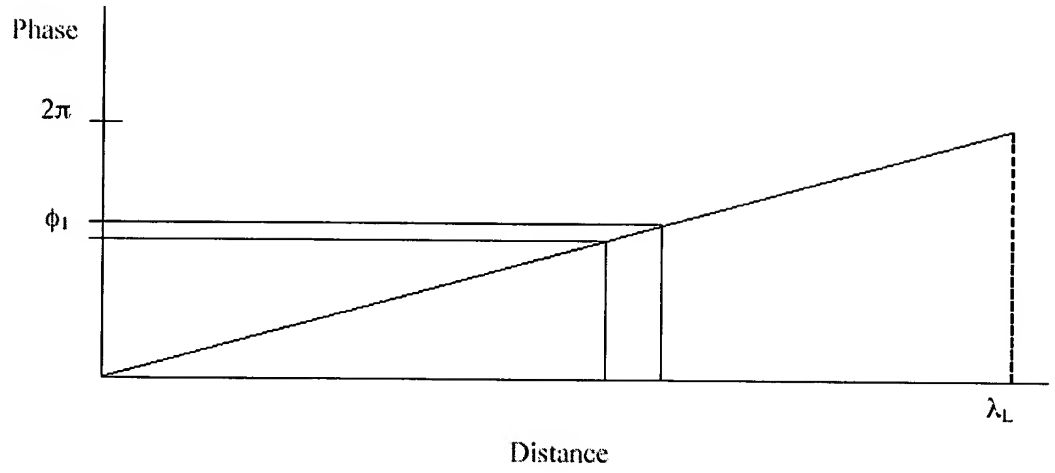


FIG. 3

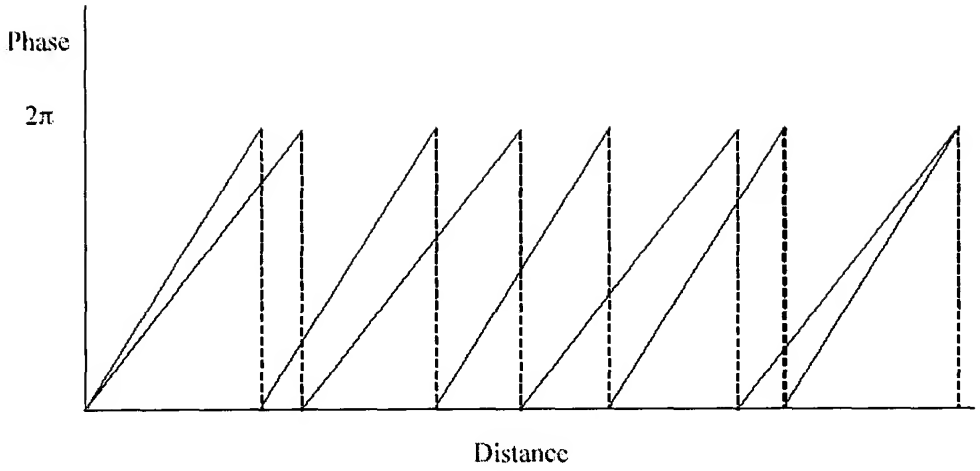


FIG. 4

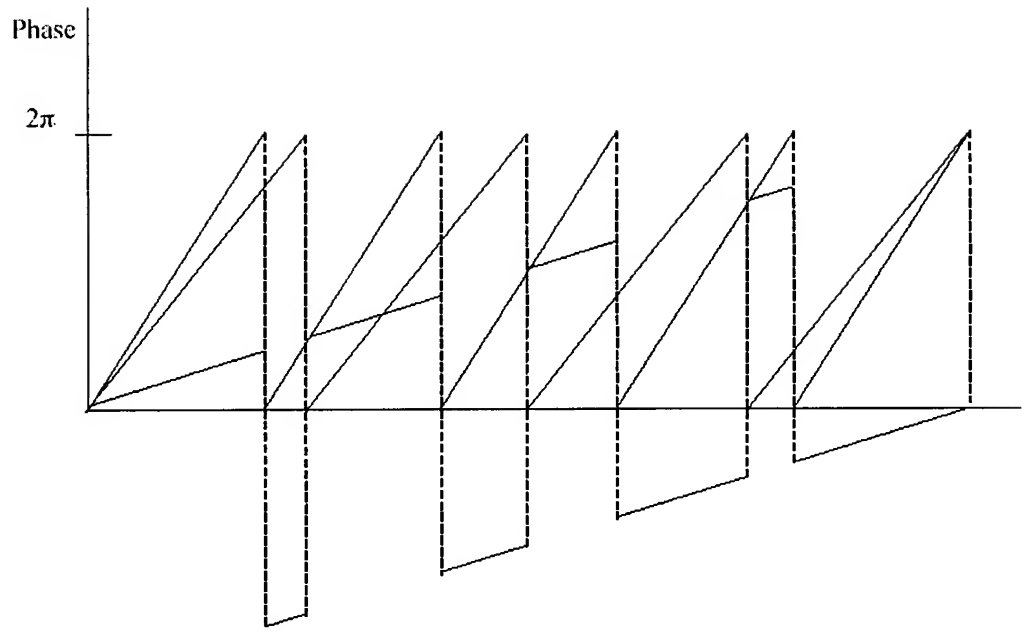


FIG. 5

$$H = |O + R|^2 \tag{2.1}$$

$$H = |O|^2 + O^*R + OR^* + |R|^2 \tag{2.2}$$

$$E(x, y; z) = \frac{-ik}{2\pi} \iint_{\Sigma} dx_0 dy_0 E_0(x_0, y_0) \frac{e^{ikr}}{r} \tag{2.3}$$

$$\phi = m \cdot x \tag{2.4}$$

$$m = \frac{2\pi(\lambda_1 - \lambda_2)}{\lambda_1 \lambda_2} \tag{2.5}$$

$$\lambda_2 \geq \frac{\Delta\varphi}{m} = \frac{\Delta\varphi \lambda_1 \lambda_2}{2\pi(\lambda_1 - \lambda_2)} \tag{2.6}$$

$$\Delta\varphi_b = \frac{2\pi(\lambda_1 - \lambda_2)}{\lambda_2} \tag{2.7}$$

$$\Delta\varphi_s = \frac{\Delta\varphi_b}{2} = \frac{\pi(\lambda_1 - \lambda_2)}{\lambda_2} \tag{2.8}$$

$$x_r = \frac{\lambda_1 \lambda_2}{\lambda_1 - \lambda_2} \tag{2.9}$$

$$x_r = \frac{\pi \lambda_1}{\Delta\varphi_s} \tag{2.10}$$

$$\Delta x = \frac{\Delta\varphi_s \lambda_2}{2\pi} \tag{2.11}$$

$$\lambda_1 = \frac{x_r \lambda_2}{x_r - \lambda_2} \tag{2.12}$$

FIG. 6

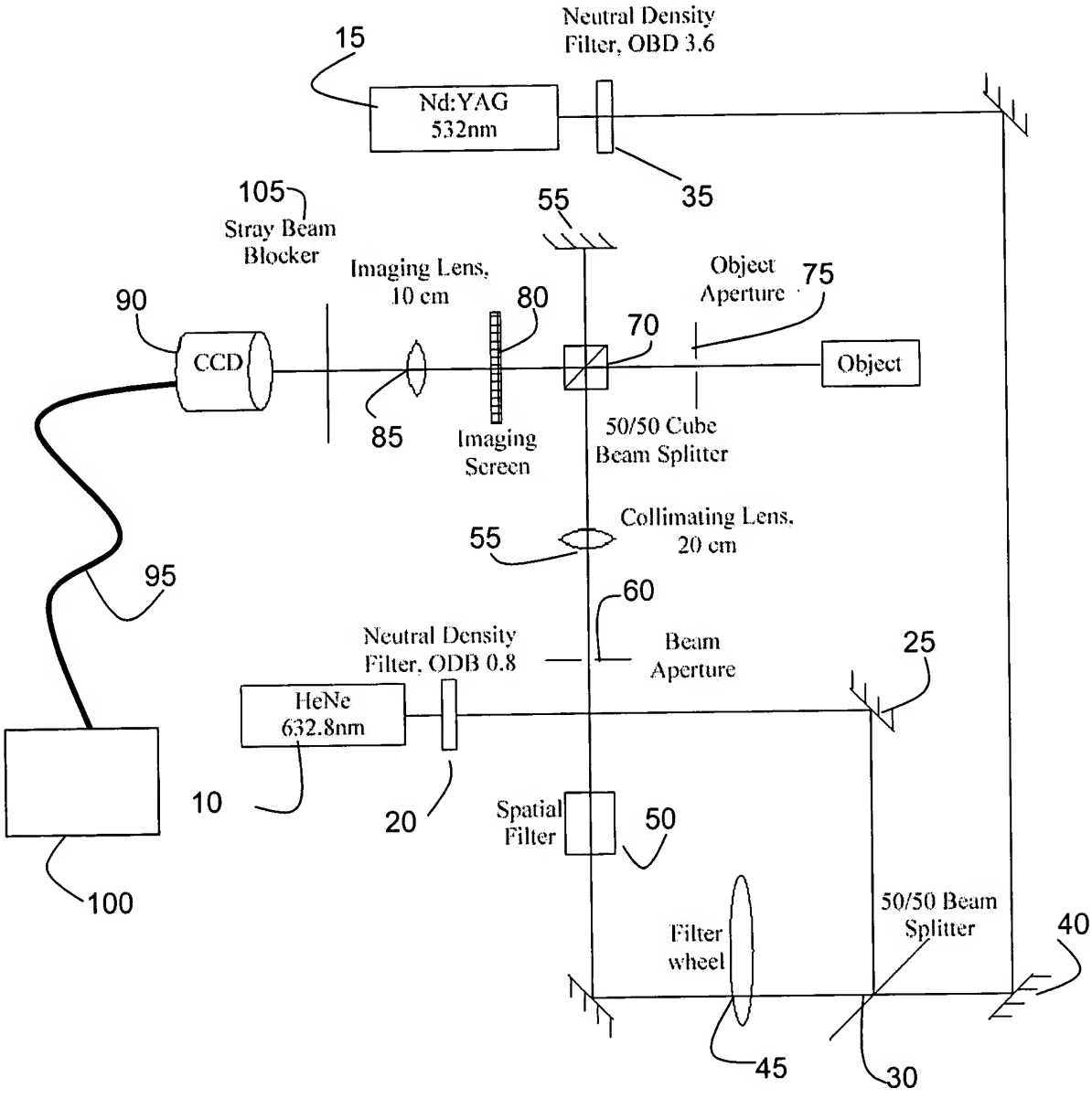

Neutral Density
Filter, OBD 3.6
15
Nd:YAG
532nm
35
105
Stray Beam
Blocker
55
Imaging Lens,
10 cm
Object
Aperture
75
90
80
70
CCD
Object
85
Imaging
Screen
50/50 Cube
Beam Splitter
55
Collimating Lens,
20 cm
95
60
Neutral Density
Filter, ODB 0.8
Beam
Aperture
25
HeNe
632.8nm
10
20
Spatial
Filter
50
100
Filter
wheel
50/50 Beam
Splitter
40
45
30

FIG. 7

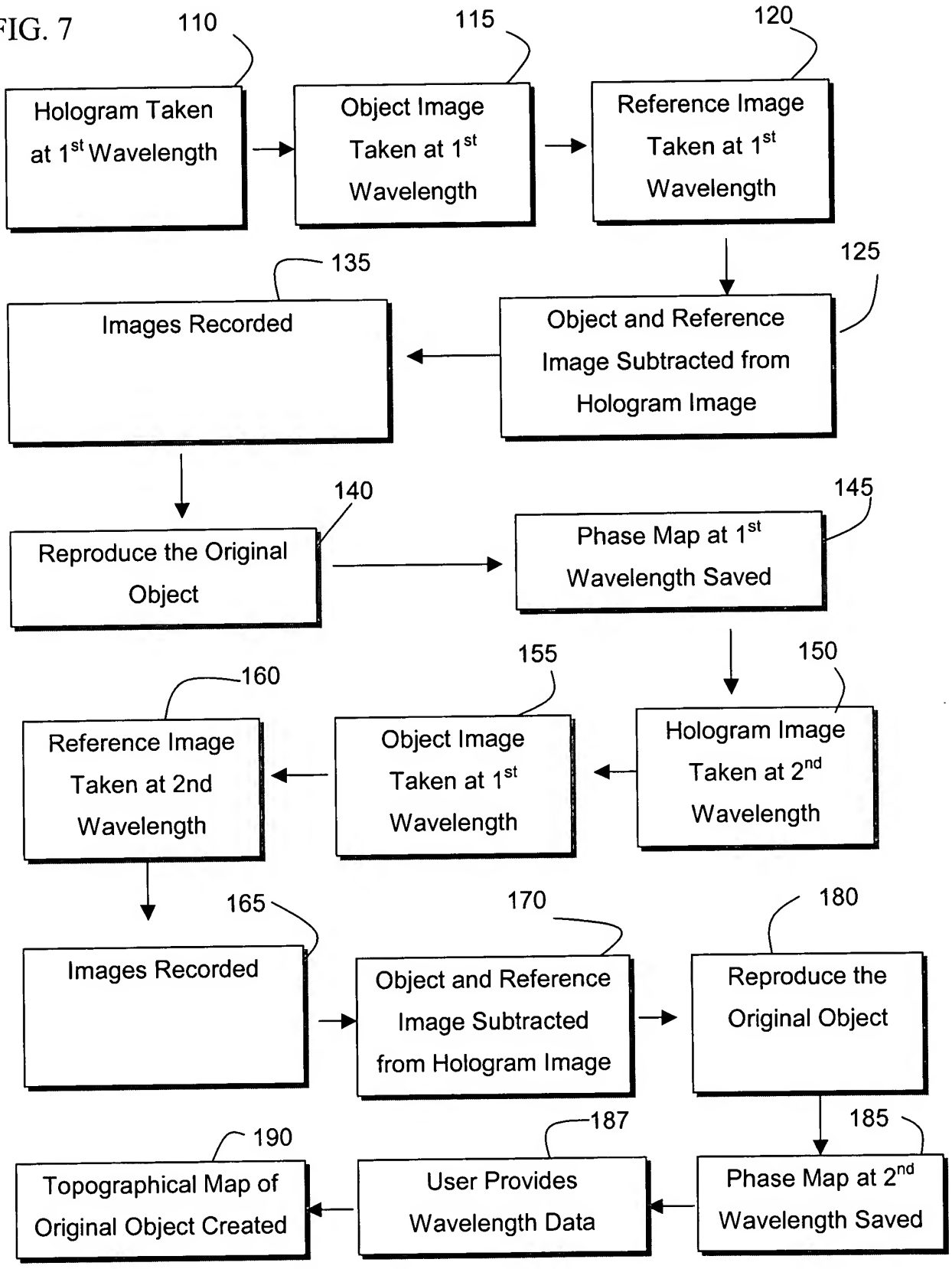

110
Hologram Taken at 1st Wavelength
115
Object Image Taken at 1st Wavelength
120
Reference Image Taken at 1st Wavelength
125
Object and Reference Image Subtracted from Hologram Image
135
Images Recorded
140
Reproduce the Original Object
145
Phase Map at 1st Wavelength Saved
150
Hologram Image Taken at 2nd Wavelength
155
Object Image Taken at 1st Wavelength
160
Reference Image Taken at 2nd Wavelength
165
Images Recorded
170
Object and Reference Image Subtracted from Hologram Image
180
Reproduce the Original Object
185
Phase Map at 2nd Wavelength Saved
187
User Provides Wavelength Data
190
Topographical Map of Original Object Created

FIG. 8

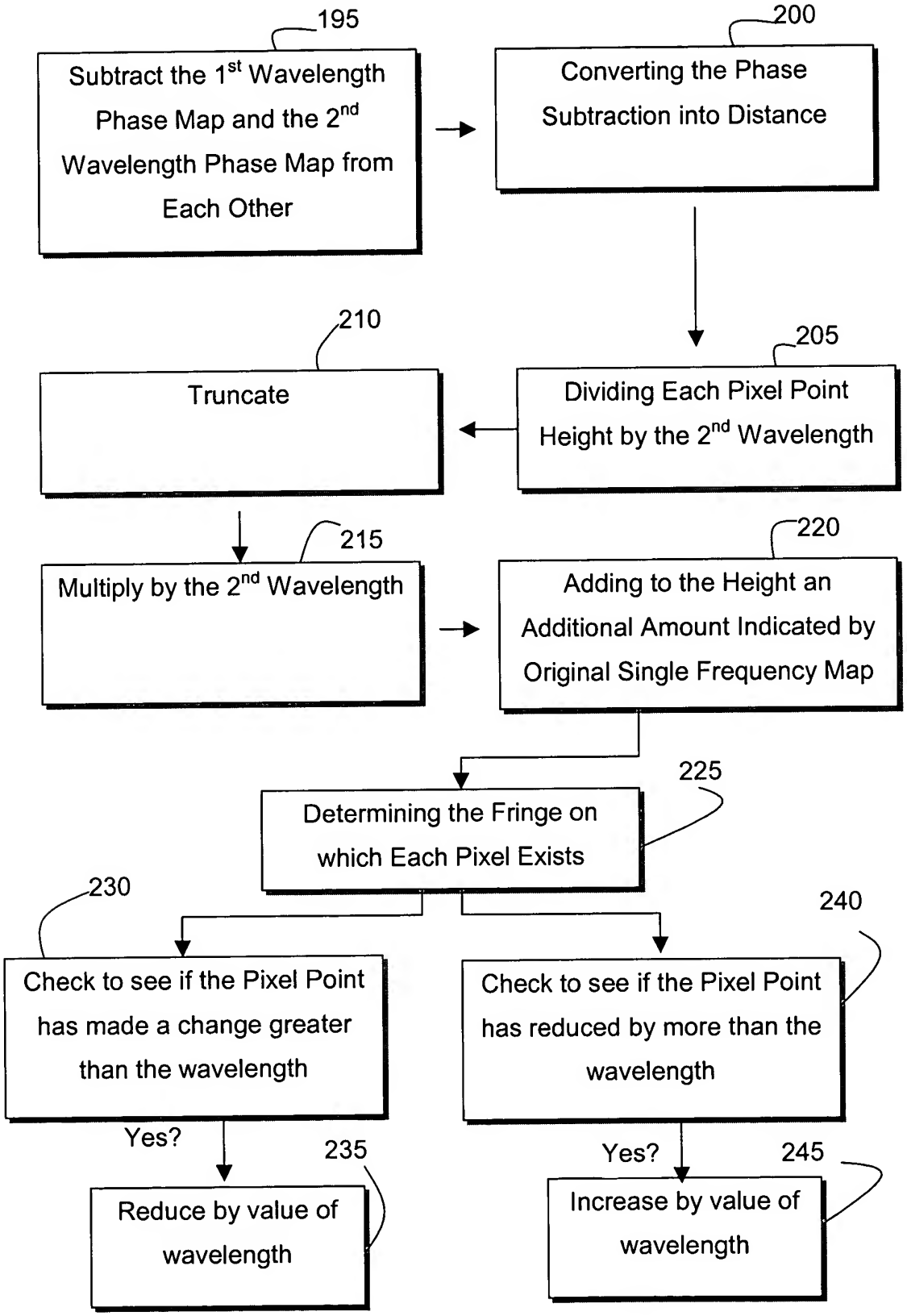

195
Subtract the 1st Wavelength Phase Map and the 2nd Wavelength Phase Map from Each Other
200
Converting the Phase Subtraction into Distance
205
Dividing Each Pixel Point Height by the 2nd Wavelength
210
Truncate
215
Multiply by the 2nd Wavelength
220
Adding to the Height an Additional Amount Indicated by Original Single Frequency Map
225
Determining the Fringe on which Each Pixel Exists
230
Check to see if the Pixel Point has made a change greater than the wavelength
Yes?
235
Reduce by value of wavelength
240
Check to see if the Pixel Point has reduced by more than the wavelength
Yes?
245
Increase by value of wavelength

FIG. 9

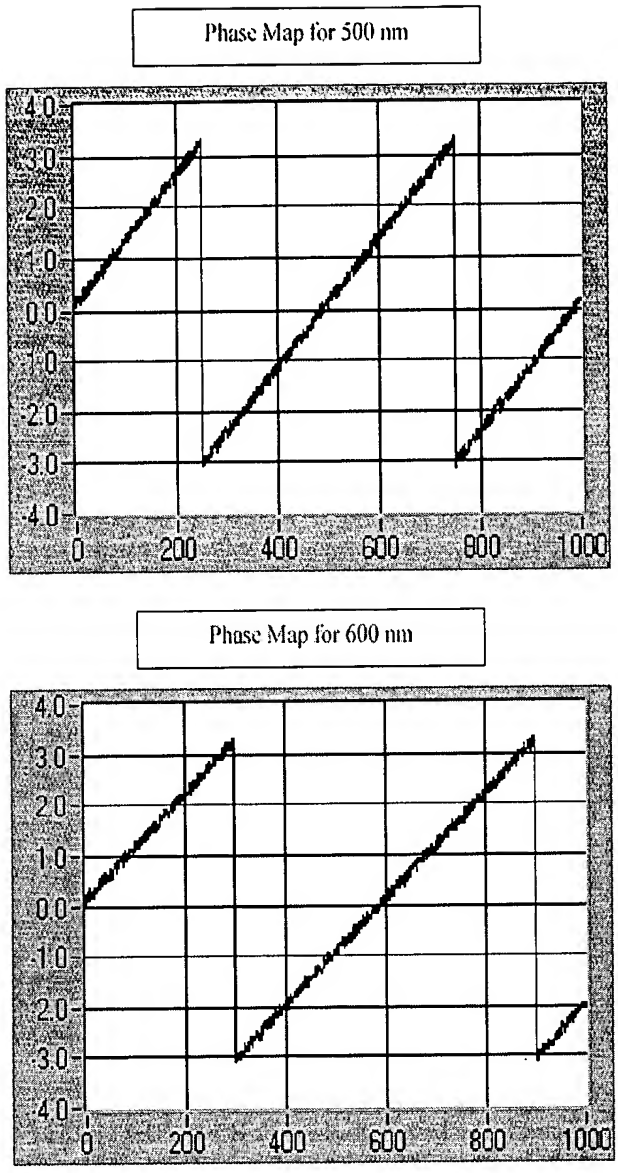

Phase Map for 500 nm
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
0
200
400
600
800
1000
Phase Map for 600 nm
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
0
200
400
600
800
1000

FIG. 10

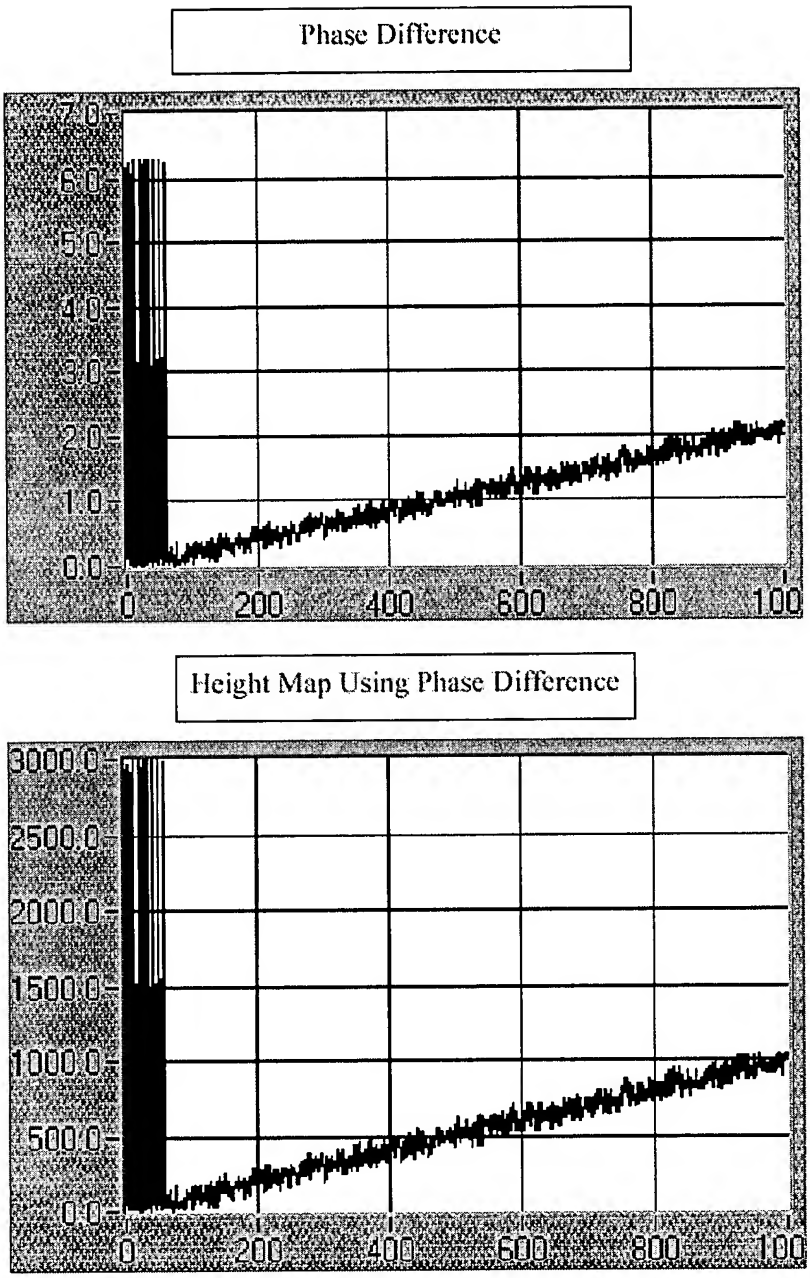

Phase Difference
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0
200
400
600
800
100
Height Map Using Phase Difference
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0
200
400
600
800
100

FIG. 11

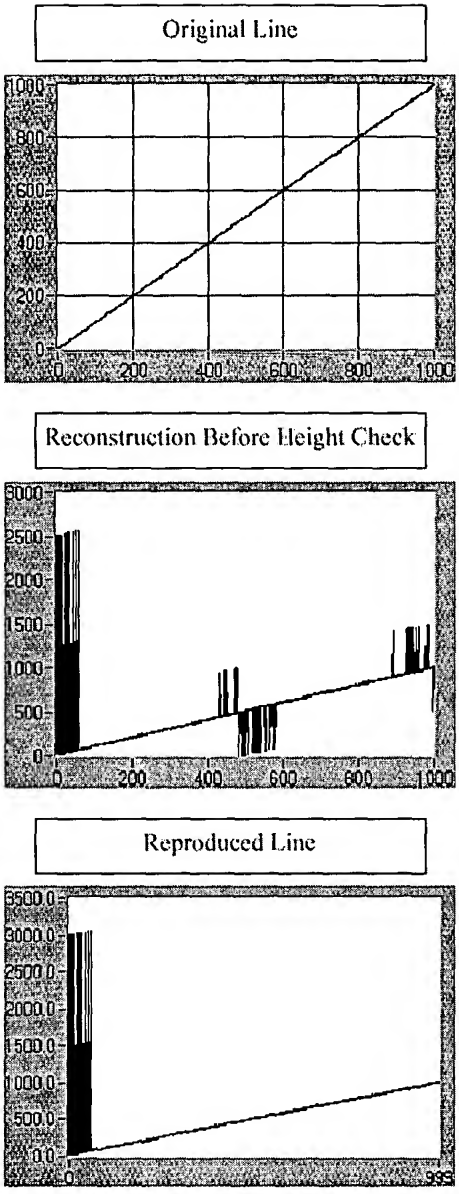
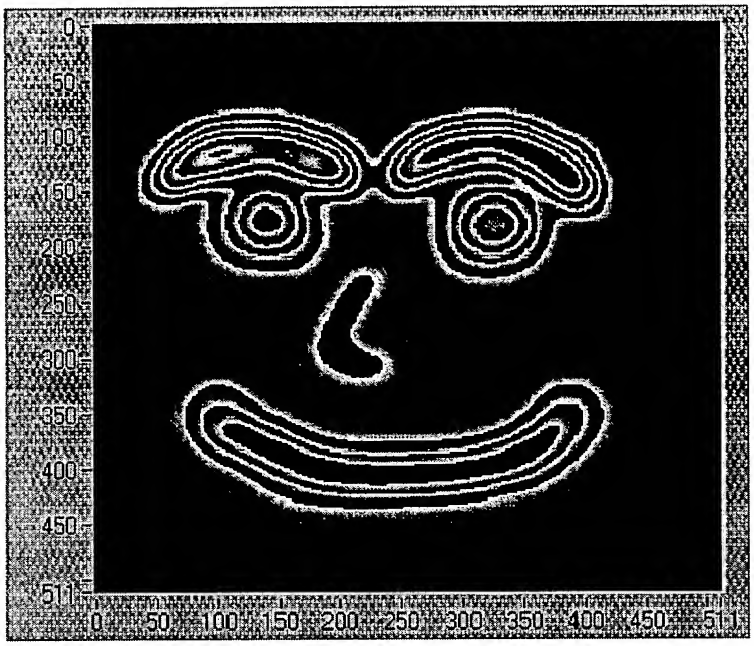

Original Line
1000
800
600
400
200
0
0
200
400
600
800
1000
Reconstruction Before Height Check
3000
2500
2000
1500
1000
500
0
0
200
400
600
800
1000
Reproduced Line
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
0
999

FIG. 12

Phase Plot For 532 nm



Phase Plot For 632 nm

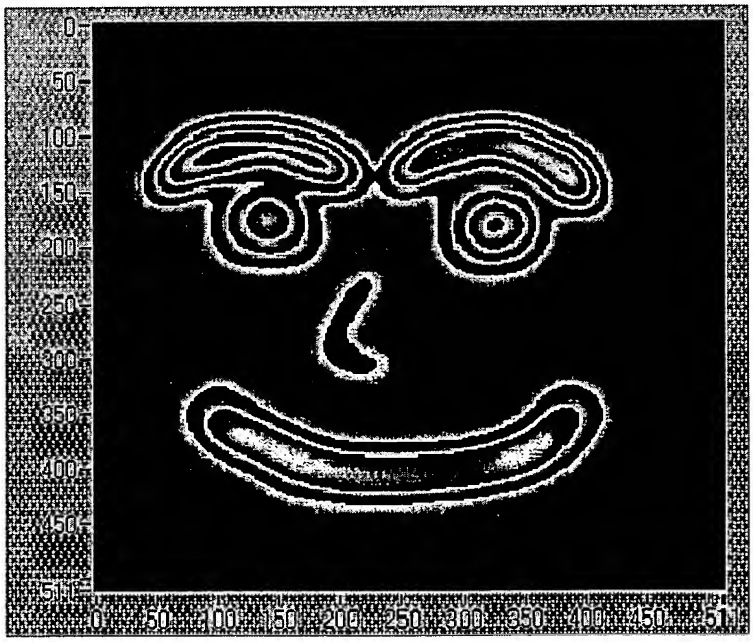


FIG. 13

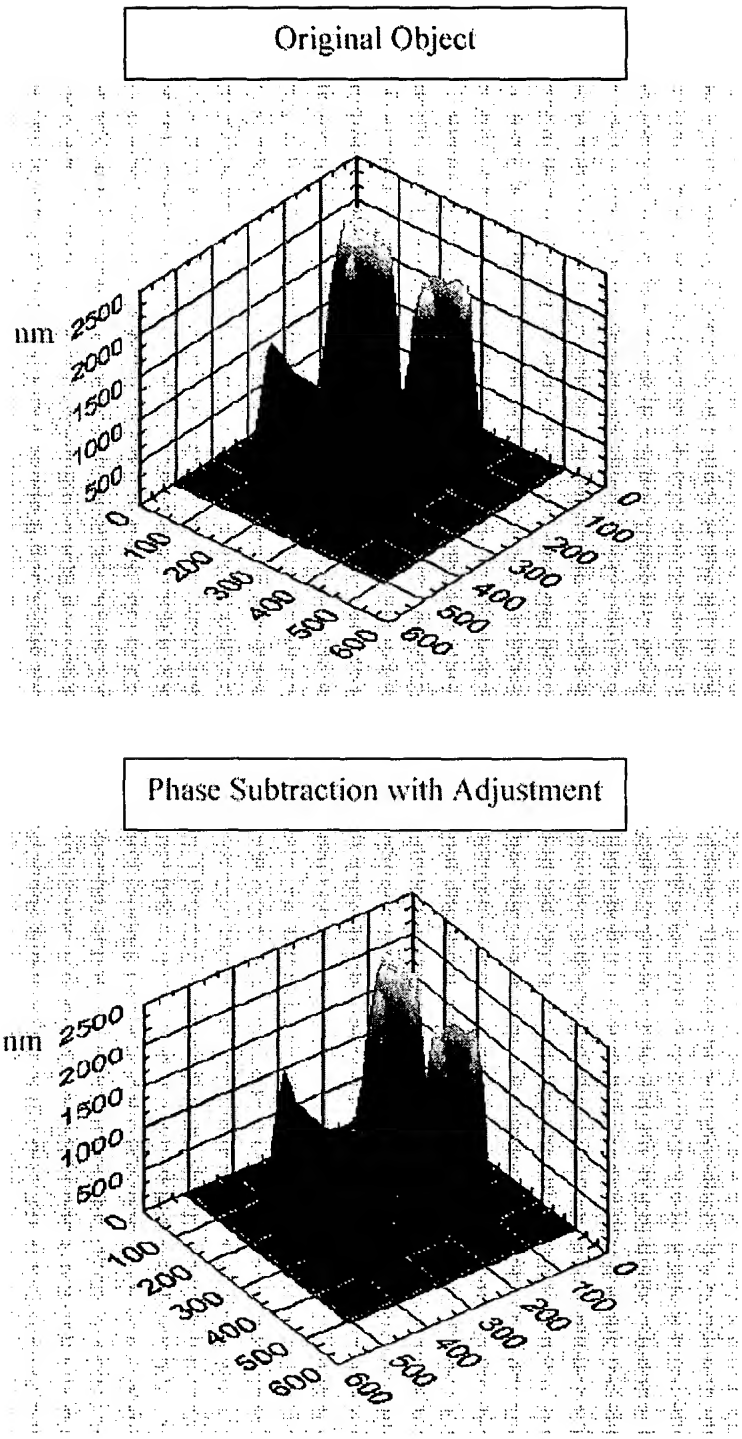
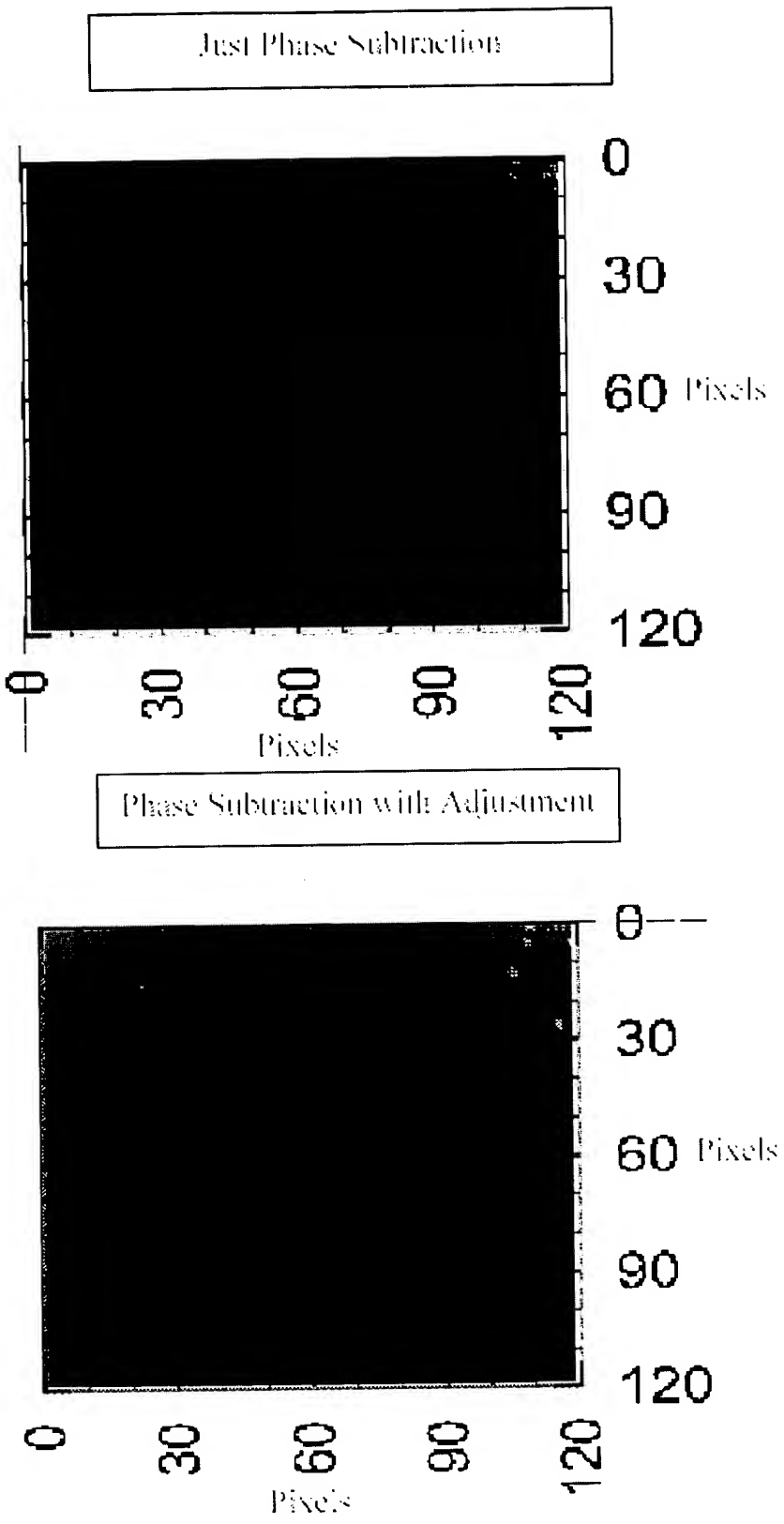
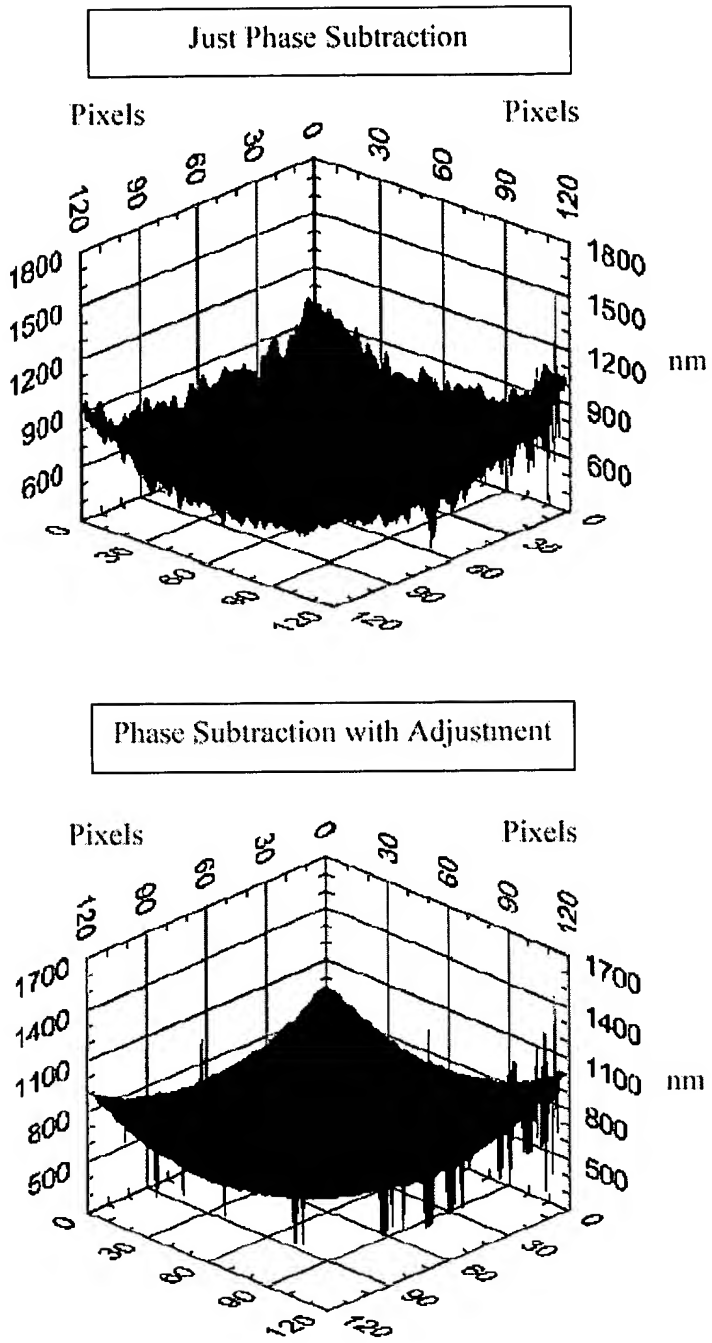

Original Object
nm
2500
2000
1500
1000
500
0
100
200
300
400
500
600
Phase Subtraction with Adjustment
nm
2500
2000
1500
1000
500
0
100
200
300
400
500
600

FIG. 14



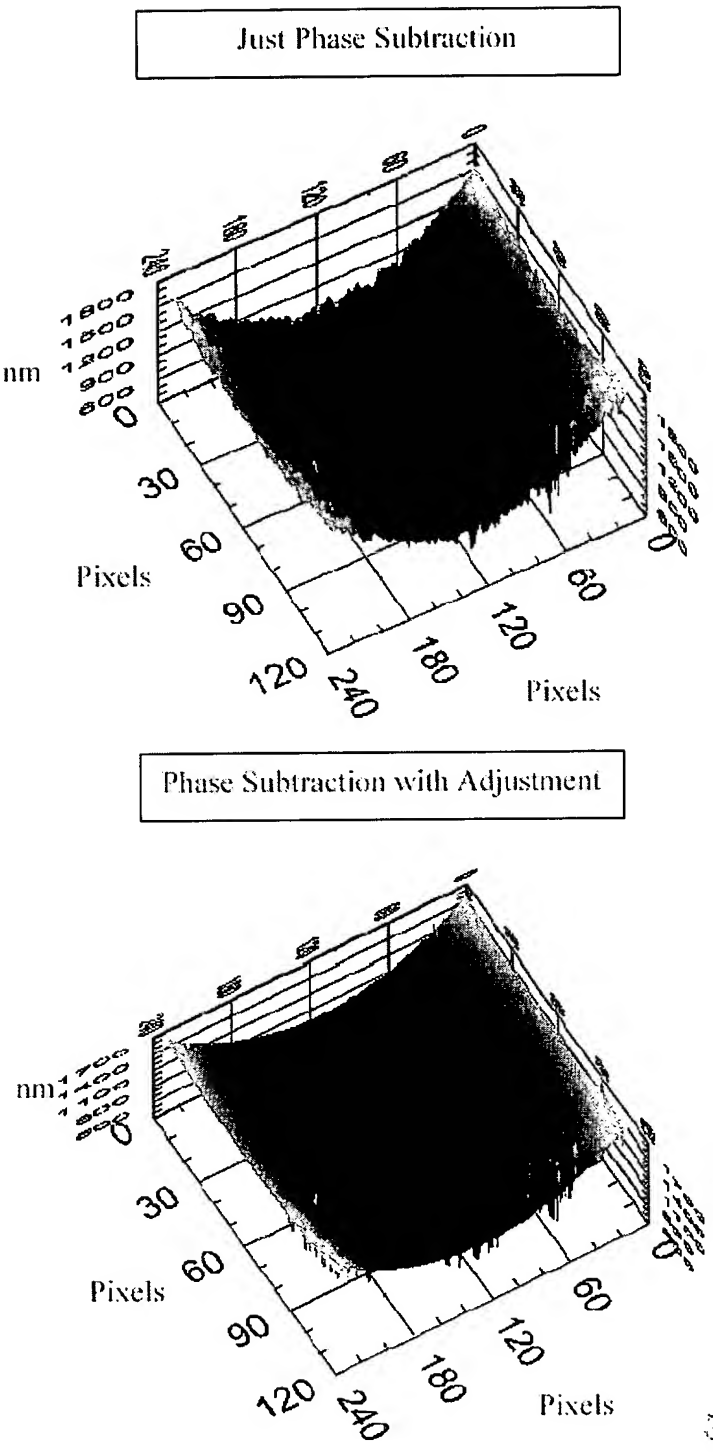
BEST AVAILABLE COPY

FIG. 15



BEST AVAILABLE COPY

FIG. 16



BEST AVAILABLE COPY

FIG. 17

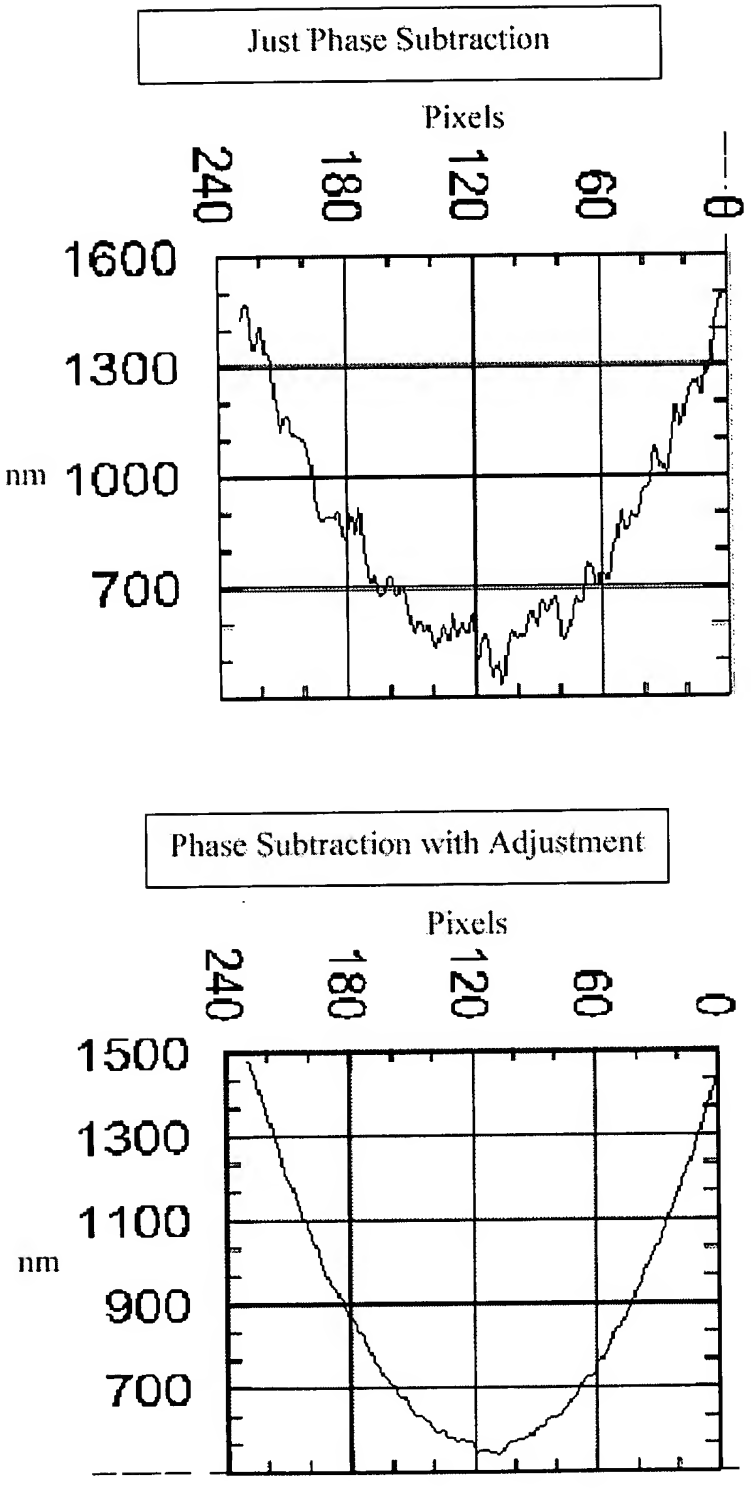

Just Phase Subtraction
Pixels
240
180
120
60
0
1600
1300
nm 1000
700
Phase Subtraction with Adjustment
Pixels
240
180
120
60
0
1500
1300
1100
nm
900
700

FIG. 18

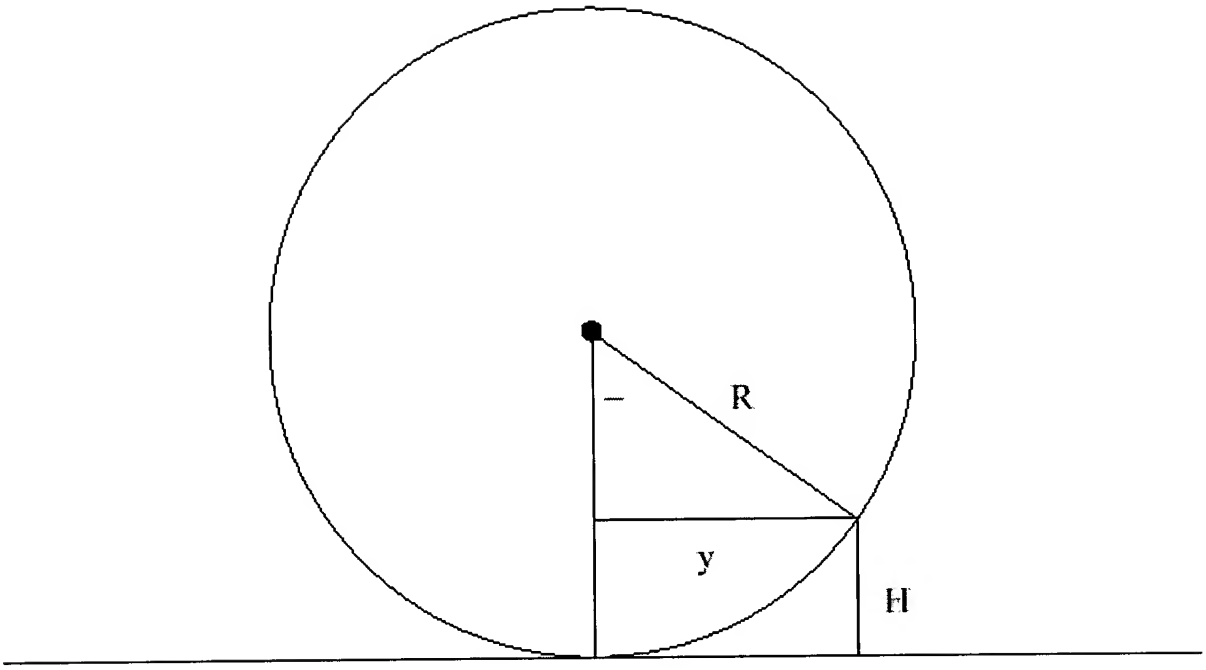


FIG. 19

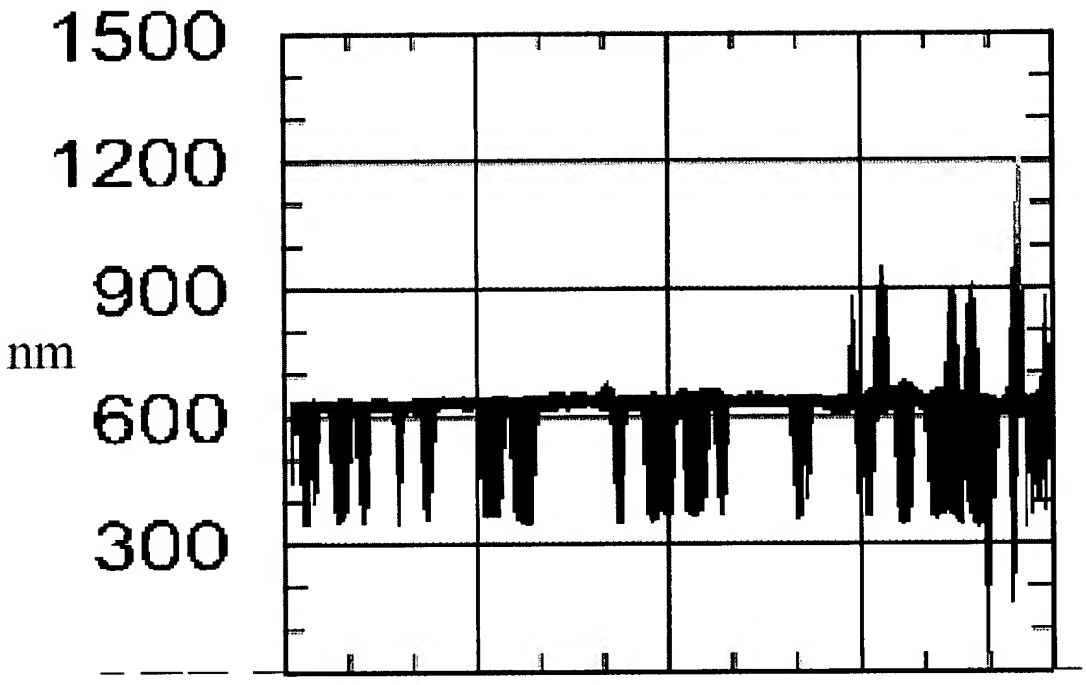


FIG. 20

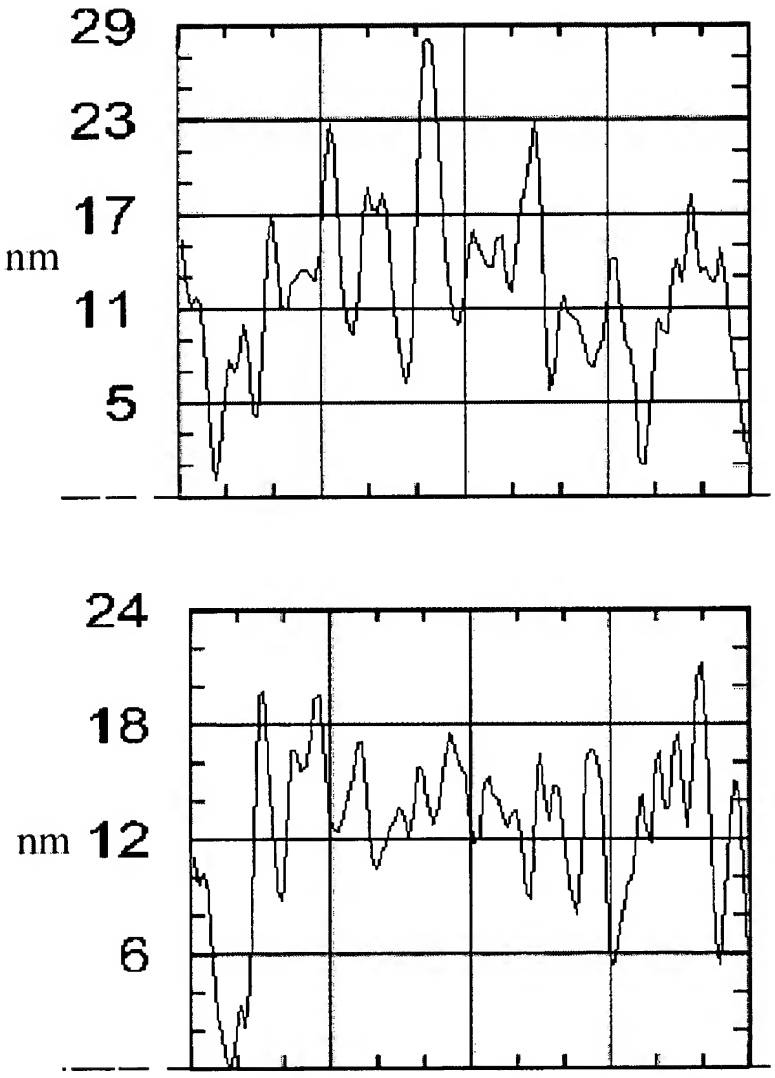


FIG. 21

$$R - R\cos\theta = H \tag{7.1}$$

$$\cos\theta = 1 - \frac{\theta^2}{2} \tag{7.2}$$

$$\theta = \sin\theta = \frac{y}{R} \tag{7.3}$$

$$R - R\left(1 - \frac{y^2}{2R^2}\right) = H \tag{7.4}$$

$$R = \frac{y^2}{2H} \tag{7.5}$$

FIG. 22

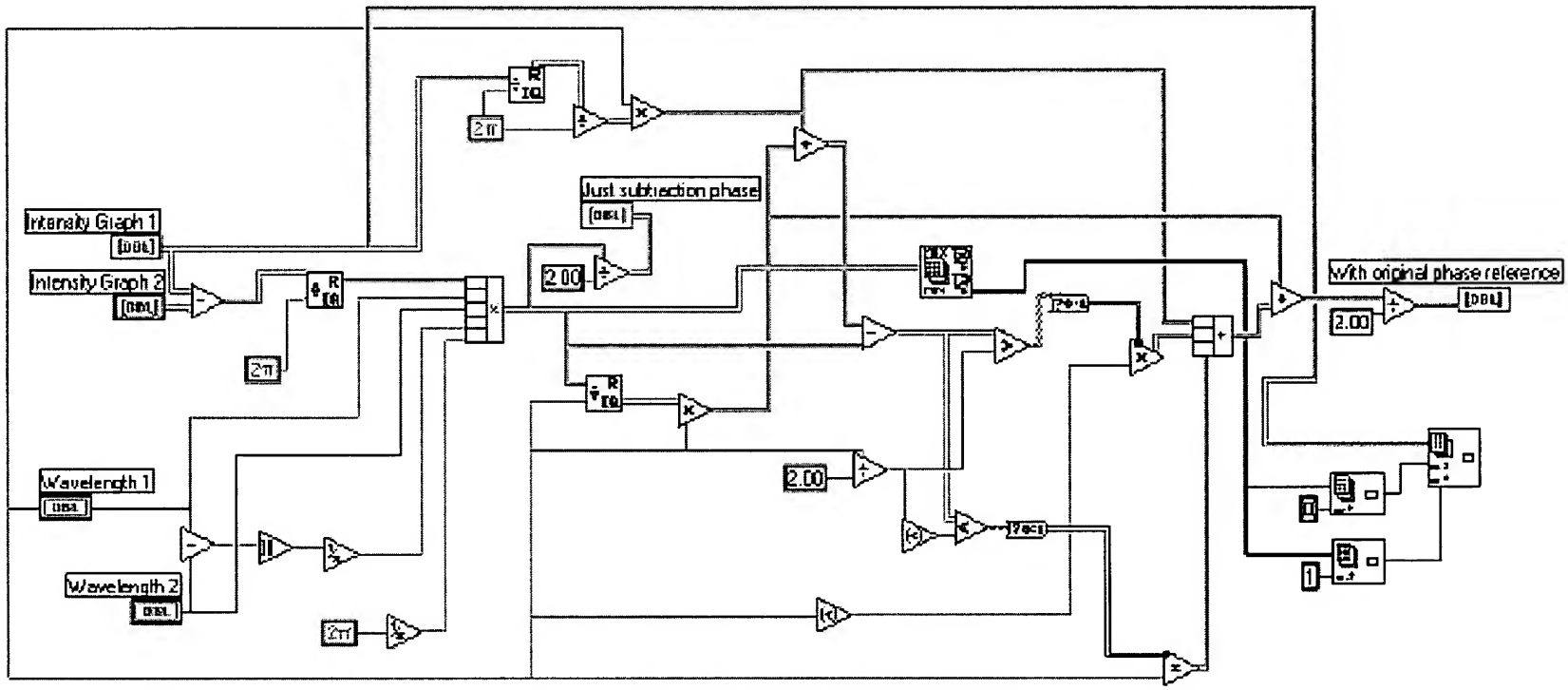
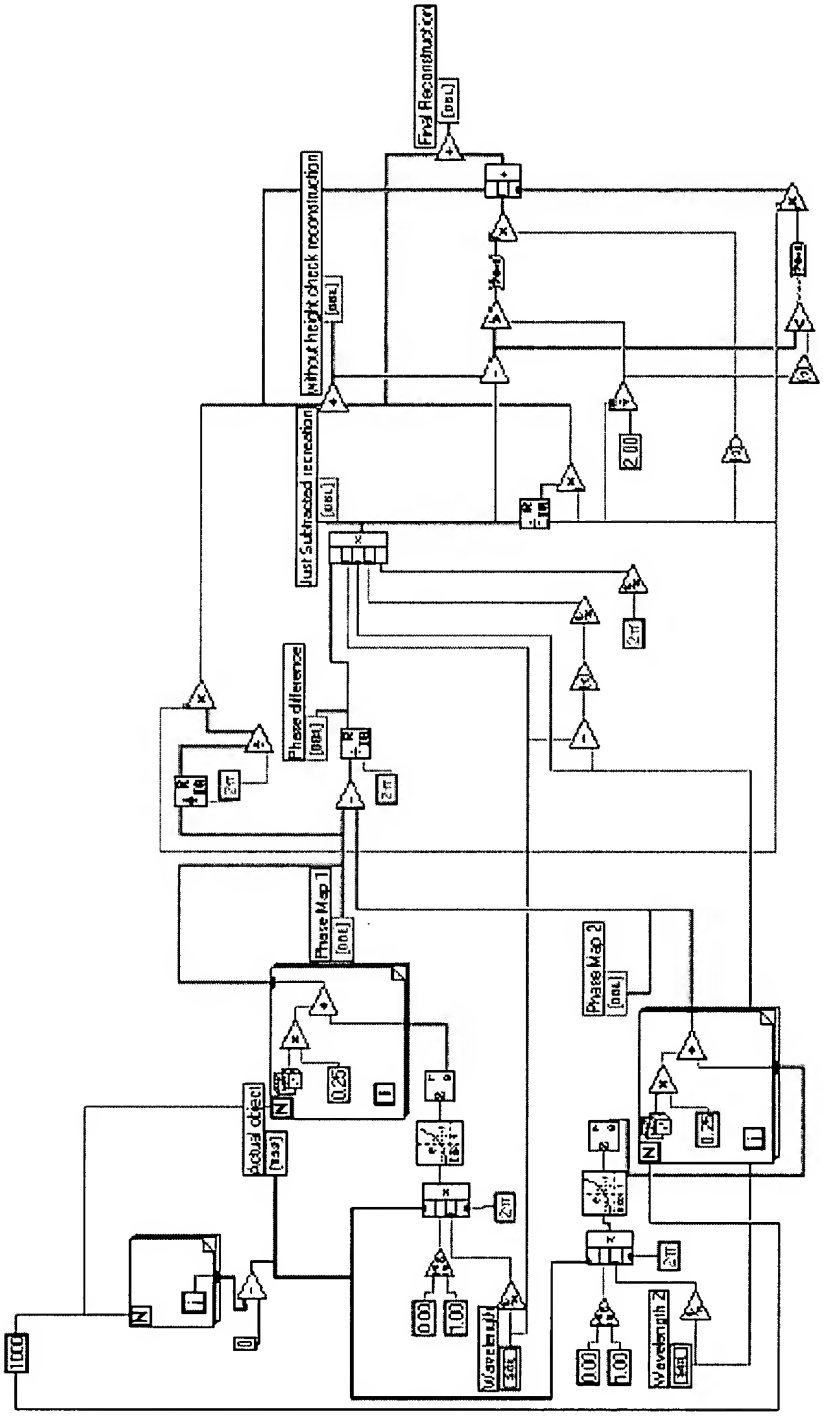

Intensity Graph 1
Intensity Graph 2
Wavelength 1
Wavelength 2
Just subtraction phase
2.00
2π
With original phase reference

FIG. 23


Final Reconstruction
Without height check reconstruction
Just Subtracted reconstruction
Phase difference
Phase Map 1
Phase Map 2
Wavelength
Wavelength 2
2.00
0.25
0.00
1.00

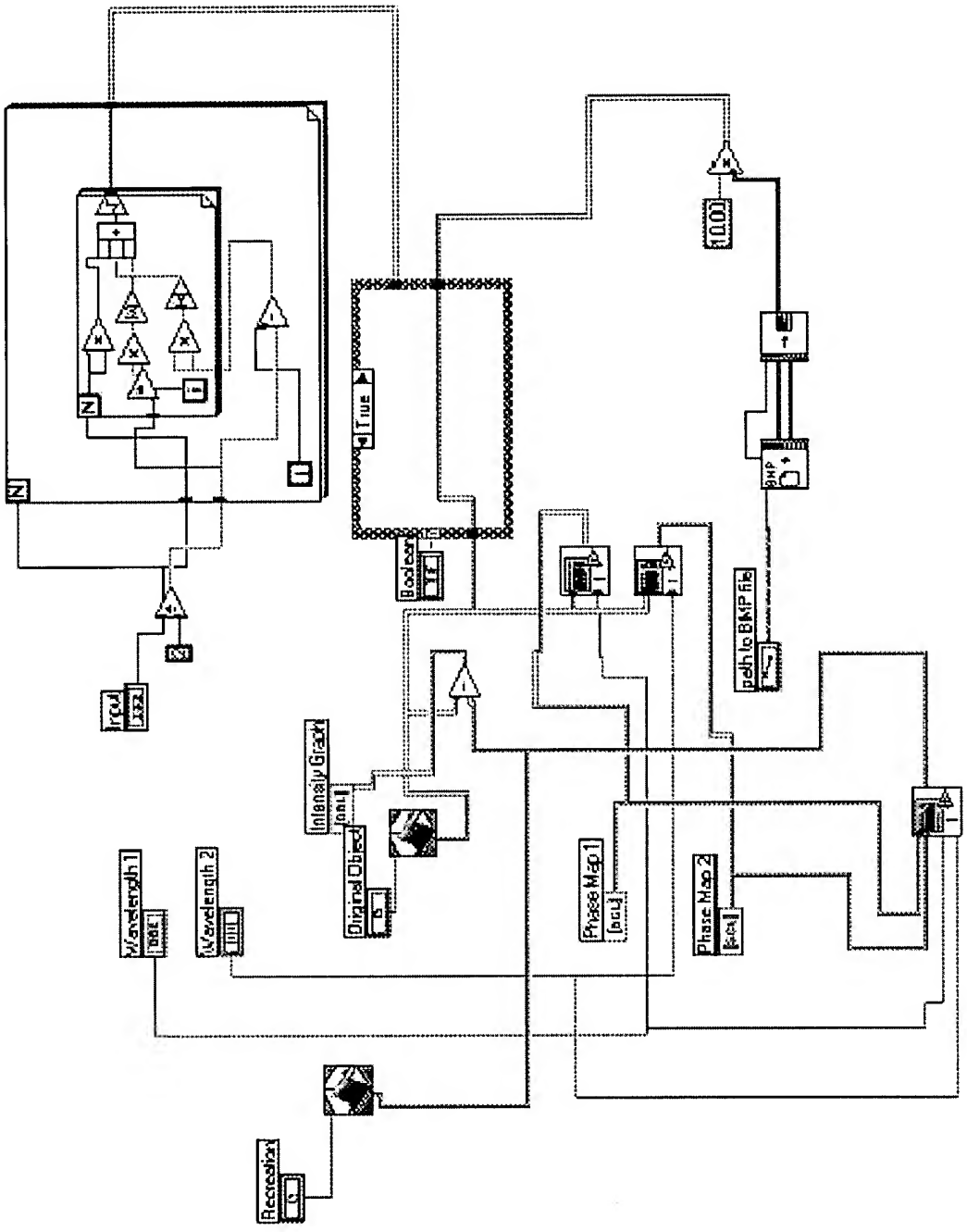

Wavelength 1
Wavelength 2
Intensity Grads
Original Object
Phase Map 1
Phase Map 2
Boolean
True
path to BMP file
BMP
Recreation

FIG. 24

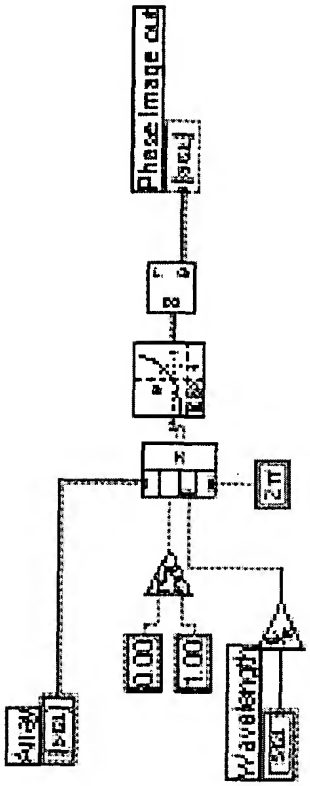



FIG. 25